

**YOUR
ISTRC SYSTEMTM
REPORT**

**KINIPELA
GOLF CLUB**

January 30, 2009
Green 1
Lab ID: 09010004

Presented To:

Mr. Rob Crompton, Turf Consultant

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January 30, 2009

Mr. Rob Crompton, Turf Consultant
KINIPELA GOLF CLUB
2500 Jeanine Dr.
Victoria, B.C. Canada V9B 4X9

re: Lab ID: 09010004; ISTRC SYSTEM™ BenchMarking of undisturbed core samples from Green #1 – 1st, 2nd & 3rd tier.

Dear Rob;

We have completed the ISTRC SYSTEM™ BenchMarking of the undisturbed core samples taken from Green #1 – 1st, 2nd & 3rd tier. #. The laboratory data is attached at the end of this report and pertinent time lapse photos are included with the text.

There are two sets of laboratory data attached to this report. The first set of data consists of the physical evaluation, the evaluation of the root systems, and the measurement of organic matter content by layer.

The second set of data contains the textural and particle size analysis. The textural analysis measures the percent of gravel, sand, silt & clay comprising the soil. The particle size distribution analyzes the size distribution of the sand.

There is attached at the end of this report an Aerification Displacement Chart that calculates the displacement of material by different sized hollow tines. Any section references in this report are to the **Guidebook**.

I. BACKGROUND

Green #1's three tiers were originally benchmarked in December, 2007. This report builds on the prior analysis. The current test results for each tier are compared to their prior test data in a single

table. Within each table there is a comparison index that rates whether a physical property "improved", "regressed", or showed "no change". The index is not a qualitative assessment in that a property may be appropriate for a green even though it "regressed". The index merely shows change, but over time it can identify a trend.

In our telephone conference, you described the green as performing better in 2008. Disease stressed out a large part of the green and the turf was replaced with new *Poa* sod. Nonetheless, the green has survived three feet of snow this winter maintaining good quality. For the first time you were able to aerate the green with a used Ryan aerifier. The green was hollow cored twice with 1/2" and 1/4" tines and pencil tined once with 1/4" solid tines. A verti-groomer was also purchased. The topdressing sand was changed to the material used by Bear Mountain.

Table 1 is an updated evaluation of the green's turf quality and micro-environment [growing conditions]. Through our work we have found that the numerical ratings within Table 1 are an essential part of the testing because they provide a correlation between the tested physical properties and your visual interpretation of each green.

Table 1.

Scale: 1 [bad] – 5 [moderate] – 10 [excellent]

	Turf Quality (Current)	Turf Quality (Dec. 2007)	Air Movement	Direct Sunlight	Comments
Green #1	7 to 8	6 – 7	8	3	

The sunlight rating reflects winter conditions. Direct sunlight improves to a "7" in the summer. The current turf quality rating was based on turf conditions over the majority of the year.

Continued on the next page

II. DISCUSSION OF LAB RESULTS



[The test results appear on the following pages.]

The infiltration/percolation rate properties improved in each of the three tiers. The water movement through the 2nd & 3rd tiers is excellent with percolation rates of 32.31 inches of water per hour and 37.50 in./hr., respectively. The infiltration rate in the top tier increased from 3.42 in./hr. to 5.71 in./hr. The rate remains low, but the improvement was significant. The air porosity property in the top tier – 23.21% - is capable of supporting at least 10 in./hr.

The problem with the green is the amount of biomass in the top 2 inches. This is a green that receives minimal traffic. As a consequence, thatch and root matting have increased. The matting, in particular, has not been compressed by foot traffic. As a consequence, it has not reduced the infiltration rate like it would in a green that is subjected to regular play on a golf course. The thatch/mat layer is an ideal incubator for disease. The disease pressure last year was, unfortunately, predictable. The turf would benefit from a deep dethatching/mat reduction program.

Aside from the low infiltration rate and thatch/mat issue, the green is in good condition. Root depth is shallow. The roots are currently concentrated in the top tier.



It is often assumed that *Poa annua* is a shallow rooting plant. We have tested root zones, however, with *Poa* roots over 6 inches deep. The grass will develop deep structures if the soil has the moisture and oxygen to support the growth. It is inadequate soil oxygen that is the most likely cause of shallow root systems in greens. An ancillary issue is often a build up of noxious soil gases such as carbon dioxide, methane, and sulfur dioxide.

The green is capable of supporting a deep watering program. The mechanics of a deep watering program were discussed in our telephone conference. The program we discussed will oxygenate the soil throughout the soil column.

Table 2. '+' improvement, '=' no change, '-' regressed

Green #1	Well-Drained Greens	Comparison Index* +,=,-	January 2009	Dec. 2007
Infiltration Rate [In/hr]	6 to 10	+	5.71 [remains low but good improvement]	3.42
Subsurface Air Capacity [Non-Capillary Porosity]	~20%	+	23.21% [excellent – the lack of traffic on the green has not compressed the biomass; the biomass has reduced the flow of water movement because of root structures in the air pores, but the general condition of the soil is such that it is capable of sustaining higher oxygen levels with modest changes in the maintenance program]	17.47%
Water Porosity [Capillary]	15% to 20%	+	30.50% [remains very high – water retention is a function of the biomass in the root zone, it is concentrated in the top 2 inches; moisture plus heat create an ideal environment for the incubation of diseases – the green needs a deep dethatching program to remove the excess biomass, provide room for new root structures, and reduce water retention]	32.13%
Bulk Density [g/cc]	~1.35 to 1.45	+	1.33 [remains low because of the organic matter in the top tier]	1.31
Water Holding	10% to 15%	+	22.98% [remains very high, but clearly a positive change]	24.45%
Organic Content: ¼ – 1”	1.5% to 2.5%	-	3.21% [high – this is a substantial increase over last year, it is generally indicative of healthy turf; the increase also dictates in increase in the amount of material displaced by the hollow core program]	1.74%
Organic Content: 1 – 2”	1.0% to 2.0%	-	2.46% [high – the increase was caused by mat development]	1.58%
Organic Content: 2 – 3”	0.5% to 2.0%	+	1.73% [the reduction at this depth may reflect topdressing increasing the depth of the root zone mix; if our premise is correct, this was the 1 to 2 inch depth last year]	2.45%
Organic Content: 3 – 4”	0.5% to 1.5%	-	2.19% [if the premise is correct, this used to be the 2 to 3 inch depth in 2007]	1.47%
Root Mass	at least ½ in.	=	5/8 in.	5/8 in.
Feeder Roots	at least 3.5 in. –med. density	=	Less than 3 in.	Less than 3 in.

Table 3.

+' improvement, '=' no change, '-' regressed

Green #1 2 nd tier (4-8 in.)	Well-Drained Greens	Comparison Index* +,-,=	January 2009	Dec. 2007
Infiltration Rate [In/hr]	10+	+	32.31 [excellent]	27.69
Subsurface Air Capacity [Non-Capillary Porosity]	~20%	+	27.66% [excellent]	26.23%
Water Porosity [Capillary]	Less than 20%	-	19.15% [ok – reflects the impact of the organic material in the 4 to 5 inch strata]	12.31%
Bulk Density [g/cc]	~1.40 to 1.50	-	1.51 [ok – if the bulk density continues to increase, the green may require a leaching program; at this time deep aeration or a leaching program are not recommended]	1.44
Water Holding	Less than 15%	-	12.72% [ok]	8.56%
Organic Content: 4 – 5"	0.1% to 1.5%	-	2.20% [high but acceptable, the lack of traffic on the green has not compressed the organic material into a layer that is adversely affecting percolation]	0.57%
Organic Content: 5 – 6"	0.1% to 1.5%	=	0.63% [ok]	0.52%
Organic Content: 6 – 7"	0.1% to 1.5%	=	0.70% [ok]	0.45%
Organic Content: 7 – 8"	0.1% to 1.5%	=	0.64% [ok]	0.45%
Feeder Roots	at least 3.5 in. –med. density	=	None	None

Table 4.

+' improvement, '=' no change, '-' regressed

Green #1 3 rd tier (8-12 in.)	Well-Drained Greens	Comp. Index* +,-,=	January 2009	Dec. 2007
Infiltration Rate [In/hr]	6 to 10	+	37.50 [excellent]	24.23
Subsurface Air Capacity [Non-Capillary Porosity]	~20%	+	29.12% [excellent]	24.40%
Water Porosity [Capillary]	15% to 20%	=	14.66% [remains acceptable]	14.13%
Bulk Density [g/cc]	~1.35 to 1.45	-	1.52 [need to monitor – for now, the increase in compaction has not adversely impacted the physical properties]	1.47
Water Holding	10% to 15%	=	9.65% [ok]	9.62%
Organic Content: 8 – 9"	1.5% to 2.5%	=	0.47% [ok]	0.61%
Organic Content: 9 – 10"	1.0% to 2.0%	=	0.53% [ok]	0.44%
Organic Content: 10 – 11"	0.5% to 2.0%	=	0.46% [ok]	0.47%
Organic Content: 11 – 12"	0.5% to 1.5%	=	0.53% [ok]	0.44%
Feeder Roots	at least 3.5 in. –med. density	=	None	None

Particle Distribution

The coarseness of the original greens mix sand begins at the 5 to 6 inch strata [red box]. The topdressing sand has changed the distribution in the top 5 inches. The top inch, however, has changed. The material retained on the 140 & 270 sieves totals more than the USGA's recommended 5% maximum. [blue box] The change may reflect the impact of your current topdressing sand. In conjunction with the organic material, it is capable of creating a layer that will be an impediment to both air and water movement. The good news is that the lack of traffic has not compressed the material into an impervious layer.

LAB ID NO.	SAMPLE NAME	Sand	Silt	Clay	Gravel	Very Coarse	Coarse	Medium	Medium	Med/Fine	Fine	Very Fine
		USDA (mm) U.S. Sieve (mesh)	.05 to 2.00 270 to 18	.002 to .05 (Pan)	<.002 (Pan)	2.00 10	1.00 18	0.50 35	0.25 60	0.18 80	0.15 100	0.10 140
		% Retained on Sieve										
09010004-G01	25 - 1.0 in.	97.75	0.65	0.65	0.95	4.08	20.53	47.93	14.80	4.08	4.38	1.95
Green #1	1.0 - 2.0 in.	97.82	0.62	0.63	0.93	2.60	20.65	50.60	14.88	3.93	3.63	1.53
1st Tier	2.0 - 3.0 in.	97.29	1.03	1.03	0.65	3.45	21.38	49.20	14.25	3.88	3.75	1.38
	3.0 - 4.0 in.	97.97	0.85	0.85	0.33	7.23	24.95	40.88	14.05	4.25	4.63	1.98
09010004-G01	4.0 - 5.0 in.	96.97	1.15	1.15	0.73	9.38	24.20	39.43	13.53	4.00	4.53	1.90
Green #1	5.0 - 6.0 in.	96.37	0.62	0.63	2.38	27.20	27.88	27.95	7.80	2.13	2.33	1.08
2nd Tier	6.0 - 7.0 in.	98.47	0.20	0.20	1.13	18.35	26.13	32.50	11.88	3.33	4.13	2.15
	7.0 - 8.0 in.	95.80	0.80	0.80	2.60	30.58	26.33	25.85	7.15	2.23	2.43	1.23
09010004-G01	8.0 - 9.0 in.	95.96	0.75	0.76	2.53	23.08	29.20	28.75	8.15	2.58	2.85	1.35
Green #1	9.0 - 10.0 in.	94.86	0.88	0.88	3.38	21.03	33.25	28.00	6.95	2.15	2.33	1.15
3rd Tier	10.0 - 11.0 in.	95.17	0.86	0.87	3.10	20.70	28.20	29.80	8.93	2.73	3.23	1.58
	11.0 - 12.0 in.	76.54	0.45	0.46	22.55	20.35	22.50	22.13	6.23	2.05	2.18	1.10
USGA		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At least 60		20 Max.		5 Max.	
Recommended Specifications			10 Max. w/ Fine & V.F.		10 Max.						10 Max. w/Silt & Clay	

Continued on the next page

III. SUMMARY

Our general recommendations are contained in Section V – *Maintenance Practices* – on page 20 of **The ISTRC Guidebook**. We encourage you to read this section.

The recommended displacement target for this year is 25% with a minimum of 20%. Your options are dependent on the capabilities of your Ryan. Quad block spacing may be too tight. That is, tight spacing may pull the turf. If quad block spacing [1.5” x 1.5”] is an option, 0.50” tines will displace 8.7% per pass. Both CTI and JRM, however, produce 0.58” OD side eject tines with 3/8” shanks for quad blocks. Both sets of tines have 0.40” ID. The slightly larger tine increases the displacement to 11.7% per pass on quad block spacing. On standard 2” x 2” spacing the 0.50” tines displace 4.9% but the 0.58” tines displace 6.6%. If the 2” x 2” spacing is used, double passes will be required in the spring and fall to reach the 25% target.

The development of the thatch/mat layering requires a deep dethatching program. Verticutting/grooming the green on a regular basis is necessary to control current thatch production. It is not deep enough, however, to remove the material below the top half inch. Small [1/4”] hollow quads are needed. It is important that the quads effectively remove at least 2 inches of material. The plugs should be blown off the green, but it is our recommendation to leave the holes open. Many of our clients will groom, topdress, and roll at the same time. You should plan for at least three applications during the growing season.

The hollow tines mechanically remove material. We also recommend removing material through decomposition. Decomposition requires soil oxygen. Oxygen is a depleting resource. It is consumed by the roots and microbes. As a consequence, it must be constantly replenished. There is an exchange of soil gases in the upper part of the root zone with oxygen rich air from the atmosphere. The infiltration rate – which is an indirect measurement of air permeability – indicates that the exchange is not efficient. As a consequence, we cannot expect “normal” gas exchange to maintain soil oxygen below the top 2 inches. Regular aeration with needle tines will be necessary. Non-disruptive aeration at least every 2 weeks is recommended with the small hollow quads substituted at least once per month – stress permitting. Regular aeration is also required to keep the sodded turf from pruning to the sod layer.

Deep watering is an effective method of oxygenating the entire root zone. In an USGA-style green, deep watering requires applying water until the weight of the water in the soil column breaks the tension of the perched water table. A vacuum is created pulling excess water from the air pores and drawing oxygen into the vacated spaces. The process firms the surface and can be used to cool the soil.

Finally, we recommend that you continue to monitor your green with at least annual testing. We remain available to answer questions and discuss ideas with you.

Sincerely,

I.S.T.R.C.

by:

Robert S. Oppold, V.P. – R&D

I.S.T.R.C.
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INVOICE
ISTRC EIN: 48-1078972

Invoice Number:

080030

Company: KINPELA GOLF CLUB		Facility: Green 1
Address: 2500 Jeanine Dr.		Material tested: N/A
City: Victoria, B.C. Canada V9B 4X9		Invoice Date: January 30, 2009
Attention: Mr. Rob Crompton, Turf Consultant		Due Date: N/A
Phone: 250-391-9915	Secondary Phone or E-mail:	Fax:
Lab ID #: 09010004	Customer Rep.: N/A	Account No.: 2509915

Thank You For Your Business

<i>Quantity</i>	<i>Description</i>	<i>Unit Price</i>	<i>Invoiced Amount</i>
3	ISTRC SYSTEM Undisturbed Core Analysis Complimentary testing:	\$450.00	\$1,350.00 -\$1,350.00
TOTAL DUE THIS INVOICE:			\$ 0.00

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The I.S.T.R.C. System™

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 Name: Mr. Rob Crompton, Turf Consultant
 Address: 2500 Jeanine Dr.
 City, ST, Zip: Victoria, B.C. V9B 4X9

Account No. 2509915

Date 26-Jan-09

Facility Kinipela G.C.

ISTR Rep. N/A

Physical Evaluation

ISTR SYSTEM™ Core Analysis

LAB ID NO.	SAMPLE NAME	Infiltration Rate in/hr	40 cm Water Holding %	Bulk Density g/cc	Solids %	Porosity		
						Total Porosity %	Capillary [Water Pores] %	Non-Capillary [Air Pores] %
09010004-G01	Green #1, 1st Tier	5.71	22.98	1.33	46.29	53.71	30.50	23.21
	Organic [ISTR Walkley/Black] .25 to 1 in.	3.21%				Root Mass: 5/8"		
	Organic [ISTR Walkley/Black] 1 to 2 in.	2.46%				Feeders: less than 3"		
	Organic [ISTR Walkley/Black] 2 to 3 in.	1.73%						
	Organic [ISTR Walkley/Black] 3 to 4 in.	2.19%						
09010004-G01	Green #1, 2nd Tier	32.31	12.72	1.51	53.19	46.81	19.15	27.66
	Organic [ISTR Walkley/Black] 4 to 5 in.	2.20%				Root Mass: N/A		
	Organic [ISTR Walkley/Black] 5 to 6 in.	0.63%				Feeders: none		
	Organic [ISTR Walkley/Black] 6 to 7 in.	0.70%						
	Organic [ISTR Walkley/Black] 7 to 8 in.	0.64%						
09010004-G01	Green #1, 3rd Tier	37.50	9.65	1.52	56.22	43.78	14.66	29.12
	Organic [ISTR Walkley/Black] 8 to 9 in.	0.47%				Root Mass: N/A		
	Organic [ISTR Walkley/Black] 9 to 10 in.	0.53%				Feeders: none		
	Organic [ISTR Walkley/Black] 10 to 11 in.	0.46%						
	Organic [ISTR Walkley/Black] 11 to 12 in.	0.53%						
	Organic [ISTR Walkley/Black] .25 to 1 in.					Root Mass:		
	Organic [ISTR Walkley/Black] 1 to 2 in.					Feeders:		
	Organic [ISTR Walkley/Black] 2 to 3 in.							
	Organic [ISTR Walkley/Black] 3 to 4 in.							
	USGA Sample Range [Root Zone Mix]	at least 6	10 to 20	1.4 to 1.7	45 to 65	35 to 55	15 to 25	15 to 30

Reviewed by: _____

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Account No. 2509915

Date 26-Jan-09

Facility Kinipela G.C.

ISTRC Rep. N/A

		Textural Analysis				Sand Particle Size Distribution						
		Sand	Silt	Clay	Gravel	Very Coarse	Coarse	Medium	Medium	Med/Fine	Fine	Very Fine
		.05 to 2.00	.002 to .05	<.002	2.00	1.00	0.50	0.25	0.18	0.15	0.10	0.05
		270 to 18	(Pan)	(Pan)	10	18	35	60	80	100	140	270
USDA (mm)	U.S. Sieve (mesh)	% Retained on Sieve										
LAB ID NO.	SAMPLE NAME											
09010004-G01	.25 - 1.0 in.	97.75	0.65	0.65	0.95	4.08	20.53	47.93	14.80	4.08	4.38	1.95
Green #1	1.0 - 2.0 in.	97.82	0.62	0.63	0.93	2.60	20.65	50.60	14.88	3.93	3.63	1.53
1st Tier	2.0 - 3.0 in.	97.29	1.03	1.03	0.65	3.45	21.38	49.20	14.25	3.88	3.75	1.38
	3.0 - 4.0 in.	97.97	0.85	0.85	0.33	7.23	24.95	40.88	14.05	4.25	4.63	1.98
09010004-G01	4.0 - 5.0 in.	96.97	1.15	1.15	0.73	9.38	24.20	39.43	13.53	4.00	4.53	1.90
Green #1	5.0 - 6.0 in.	96.37	0.62	0.63	2.38	27.20	27.88	27.95	7.80	2.13	2.33	1.08
2nd Tier	6.0 - 7.0 in.	98.47	0.20	0.20	1.13	18.35	26.13	32.50	11.88	3.33	4.13	2.15
	7.0 - 8.0 in.	95.80	0.80	0.80	2.60	30.58	26.33	25.85	7.15	2.23	2.43	1.23
09010004-G01	8.0 - 9.0 in.	95.96	0.75	0.76	2.53	23.08	29.20	28.75	8.15	2.58	2.85	1.35
Green #1	9.0 - 10.0 in.	94.86	0.88	0.88	3.38	21.03	33.25	28.00	6.95	2.15	2.33	1.15
3rd Tier	10.0 - 11.0 in.	95.17	0.86	0.87	3.10	20.70	28.20	29.80	8.93	2.73	3.23	1.58
	11.0 - 12.0 in.	76.54	0.45	0.46	22.55	20.35	22.50	22.13	6.23	2.05	2.18	1.10
	.25 - 1.0 in.											
	1.0 - 2.0 in.											
	2.0 - 3.0 in.											
	3.0 - 4.0 in.											
USGA		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	At least 60		20 Max.		5 Max.	
Recommended Specifications			10 Max. w/ Fine & V.F.		10 Max.						10 Max. w/Silt & Clay	
ISTRC Guidelines		89 to 100	5 Max.	3 Max.	3 Max.	10 Max.	15 to 25	40+	10 to 15	20 - #80	5 Max.	
			10 Max. w/ Fine & V.F.		10 Max.		65 to 85 Optimum			10 Max. w/Silt & Clay		

Reviewed by: _____

ISTRC

International Sports Turf Research Center Aerification Displacement Chart

Tine Size	1.25" x 1.25" Centers	1.5" x 1.5" Centers	2.0" x 2.0" Centers	2.5" x 2.5" Centers	5" x 5" Centers
1/4" Hollow Tines	3.14%	2.18%	1.23%	0.79%	
3/8" Hollow Tines	7.07%	4.91%	2.76%	1.77%	
1/2" Hollow Tines	12.57%	8.73%	4.91%	3.14%	
5/8" Hollow Tines	19.63%	13.64%	7.67%	4.91%	
5/8" Hollow Verti-Drain					1.23%
3/4" Hollow Tines				7.07%	1.77%
3/4" Hollow Verti-Drain					1.77%
1" Hollow Tines					3.14%
1" Hollow Verti-Drain					3.14%
7/8" Drill & Fill (7" Ctrs)					1.23%
Graden Verticutter (15 Blades @ 1" Spacings)	<u>1mm Blade</u> 3.93%	<u>2mm Blade</u> 7.87%	<u>3mm Blade</u> 11.81%		

Note: 1/4" Quadtines remove as much material as Regular 1/2" Hollow Tines
 3/8" minimum for ease of topdressing fill if replacement of material is required
 For double aerification make two passes at approx. 37° (slightly less than 45°) to minimize overlap

International Sports Turf Research Center, Inc.

For Additional Information Please Call:

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